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USACE / NAVFAC / AFCEA UFGS-L-15991N (February 2003)  
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Preparing Activity: LANTNAVFACENGCOM Superseding  
UFGS-L-15991N (March 2001)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

Use for LANTNAVFACENGCOM projects only

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## UNIFIED FACILITIES GUIDE SPECIFICATIONS

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### SECTION 15991N

#### INSPECTION, TESTING, AND CERTIFICATION OF BOILERS

02/03

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NOTE: This guide specification covers requirements for Contractor furnished inspection, testing, and certification (ITC) of boilers, including portable boilers. Include this specification section in projects that provide new or repair existing boilers, or direct fired water heaters with an input capacity of 400,000 Btuh or more. ITC of residential and commercial warm air furnaces or unit heaters is not required.

NOTE: Suggestions for improvement of this specification will be welcomed using the Navy "Change Request Forms" subdirectory located in SPECSINTACT in Jobs or Masters under "Forms/Documents" directory or DD Form 1426. Suggestions should be forwarded to:

Commander  
Naval Facilities Engineering Command  
Engineering Innovation and Criteria Office, Code EICO  
1510 Gilbert Street  
Norfolk, VA 23511-2699

Email: LantDiv@efdlant.navfac.navy.mil

Use of electronic communication is encouraged.

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#### PART 1 GENERAL

##### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

American Society of Mechanical Engineers (ASME)

ASME BPVC

(2000) Boiler and Pressure Vessel Codes

ASME CSD-1

(2002) Controls and Safety Devices for  
Automatically Fired Boilers

National Board of Boiler and Pressure Vessel Inspection (NBBI)

NBBI NB-23

(1998) National Board Inspection Code  
(NBIC)

## 1.2 SYSTEM DESCRIPTION

The work includes inspecting, testing, and certification of each boiler prior to acceptance by the Contracting Officer.

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NOTE: Where a "G" in submittal tags follows a submittal item, it indicates Government approval for that item. Add "G" in submittal tags following any added or existing submittal items deemed sufficiently critical, complex, or aesthetically significant to merit approval by the Government. Submittal items not designated with a "G" will be approved by the QC organization.

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## 1.3 SUBMITTALS

Submit to the NAVFACENGCOM boiler inspector licensing authority by way of the Resident Officer In Charge of Construction in accordance with Section 01330, "Submittal Procedures".

### 1.3.1 SD-07 Certificates

Experience and Qualifications of Boiler Inspector; G

Inspections and Testing Plan; G

Inspection reports and certificate; G

#### 1.3.1.1 Experience and Qualifications of Boiler Inspector

Furnish a resume verifying that the experience and qualifications of boiler inspector meet the requirements of this section; including boiler inspector's registration number from the National Board of Boiler and Pressure Vessel Inspection (NBBI).

#### 1.3.1.2 Inspections and Testing Plan

Within 30 calendar days after certification of boiler inspector, he shall submit for approval a description of the field inspection and testing procedure planned for work specified in this section. The plan shall verify compliance with the procedures specified below in paragraph "Field Inspections and Testing Procedure".

## 1.4 DEFINITIONS

## 1.5 EXPERIENCE AND QUALIFICATIONS OF BOILER INSPECTOR

The boiler inspector shall have a Certificate of Competency, and a NBBI Commission. If the boiler inspector's Certificate of Competency and NBBI

Commission are acceptable to the Boiler Inspector's Licensing Board, the Boiler inspector will be licensed by the Boiler Inspector Licensing Board of the Atlantic Division (LANTDIV), Naval Facilities Engineering Command.

#### 1.5.1 Requirements for Certificate of Competency

The boiler inspector shall have had the following education and experience:

- a. A degree in mechanical engineering from an accredited engineering college or university, plus one year of experience in design, construction, operation or inspection of high pressure boilers and pressure vessels; or
- b. A degree in a branch of engineering other than mechanical engineering from an accredited engineering college or university, plus an associate degree in mechanical technology from an accredited college or university, plus two years of experience in design, construction, operation, or inspection of high pressure boilers and pressure vessels; or
- c. A high school education, or equivalent, plus five years of experience in one of the following categories:
  1. In high pressure boiler and pressure vessel construction or repair,
  2. In charge of high pressure boiler and pressure vessel operation,
  3. In the inspection of high pressure boilers and pressure vessels.

#### PART 2 PRODUCTS - NOT USED

#### PART 3 EXECUTION

##### 3.1 GENERAL INSPECTION REQUIREMENTS

The Contractor shall be responsible for the performance of all tests and inspections as specified in this Section. All labor, equipment, and test apparatus required to accomplish the specified inspections and testing work shall be furnished by the Contractor. The Government will furnish electricity for the tests.

##### 3.2 FIELD INSPECTIONS AND TESTING PROCEDURE

Provide the following inspection and testing on each boiler in accordance with the requirements specified in NBBI NB-23 and the additional requirements specified in this Section. The inspection and testing shall be conducted by a boiler inspector who meets the experience requirements specified in Part 1 of this specification.

All tests and inspections at the site shall be made under the direction of and be subject to the approval of the Contracting Officer. Control of noise levels shall be conducted in such a manner as not to create a nuisance or hazard and shall be subject to the approval of the Contracting Officer. The tests shall include the following and shall be performed in sequence as listed:

- a. General Boiler Site Inspections

- b. External Inspection
- c. Internal Inspection
- d. Hydrostatic Tests (Strength Test and Tightness Test)
- e. Operation Tests

#### 3.2.1 Hydrostatic Tests

Subject each boiler to hydrostatic tests complying with the requirements specified in NBBI NB-23 and the following requirements:

##### 3.2.1.1 Strength Test Pressure

Each Boiler shall be tested hydrostatically to a pressure equal to 1.5 times the maximum allowable working pressure.

##### 3.2.1.2 Tightness Test Pressure

Each boiler shall be tested hydrostatically to a pressure equal to the lowest safety valve set pressure. Safety valves shall be blocked or gagged for this test.

##### 3.2.1.3 Preparation For Hydrostatic Test

- a. Remove or gag (clamp) all safety valves with appropriate devices supplied by the manufacturer. All gags (testing clamps) shall be numbered and maintained centrally. The inspector shall verify that all gags have been returned and the safety valves are set and sealed for normal operation.
- b. Install new gaskets and close tightly all manholes and handholes.
- c. Install a calibrated test gage having the proper pressure range for the hydrostatic test at the nipple provided for this purpose. If the test gage is not readily visible to the operator who will control the pressure applied, an additional calibrated pressure indicating gage shall be provided where it will be visible to the operator throughout the duration of the test. Means shall be provided so that the test pressure will not be exceeded. Make sure that all indicating gages to be used during the test have been calibrated within five days of test.
- d. Remove gages and sensors, the range of which does not equal or exceed the pressure of the proposed test, and plug the opening if cut-off valves are not provided.
- e. Make arrangements to guard against main and auxiliary stop valves being subjected at the same time to hydrostatic pressure on one side and steam pressure on the opposite side. Secure the main non-return valve and the main line stop valve and open the telltale valve between them. If possible, install a blank somewhere in the main steam line, for example, between the orifice flanges, in units in which a flow meter has been installed.
- f. Vents shall be provided at all high points of the vessel in the position in which it is to be tested to purge possible air pockets while the vessel is filling for hydrostatic test.

- g. Close all connections on the boilers, except the air cocks, water gages, pressure gages, and the valves of the line through which the pressure is to be applied. Completely fill the boilers, through the auxiliary feed line, with fresh water at the proper temperature until water overflows through the open vent. Close all vents, water gages, and valves. Care should be exercised in filling low pressure boilers to assure that boilers are not subjected to full water main pressure. Direct connection of the boilers to the water system is not prohibited where a backflow preventer is not installed to prevent contamination of the potable water system.
- h. A power driven or hand pump shall be provided for application of the test pressure. The test pump shall be provided by the Contractor and operated and inspected to ensure that it is in proper working condition prior to connecting to the vessel.

#### 3.2.1.4 Application of Pressure

Pressure shall be very carefully and slowly applied at a rate not to exceed 10 percent of the test pressure per minute, in order to prevent injury caused by air-pressurization. A person shall be stationed at the pump supplying pressure to the boiler to control its operation and at the gage to note the pressure and to maintain the pressure constant when the limiting pressure has been reached. He must be stationed where he can have direct control of the pump furnishing the pressure. The test pressure shall not be exceeded by more than 2 percent. While pressure is being built up, close observation shall be made for the conditions described in the following subparagraphs. When any of these condition are found, the test shall be stopped until the necessary corrective action has been taken.

##### a. Test Gages

If there is reason to believe that the test gage or the additional gage necessarily installed to be in view of the person controlling the test pump is in error, its calibration shall be checked. If the gage is in error, it should preferably be adjusted to read correctly, or a calibration curve may be made to indicate the correct pressure for the reading indicated by the gage. The gage indicator or the calibration curve should agree with the dead weight testing machine to within one half of one percent at test pressure.

##### b. Pressure Parts

All pressure parts shall be verified free from leaks.

If leaks are found at the tube ends of the boiler pressure parts, they should be lightly re-rolled and tested again. Tubes should not be rolled to tight; this tends to destroy the tube metal and damage the tube hole. If leakage is found in the boiler while pressure is being built up, the test shall cease until the necessary repairs have been completed to eliminate the leaks.

##### c. Possible Deformation

If any indications of probable permanent deformation are observed, the test shall cease until the weak parts have been properly

strengthened. If necessary repairs are not practicable, a new test, progressing up to 20 psi less than the pressure at which the proceeding test ceased shall be supplied. If the test is successful, the new maximum allowable working pressure shall be two-thirds of the test pressure, and the safety valves shall be reset or replaced in accordance with the new maximum allowable working pressure.

#### 3.2.1.5 Hold Pressure

Upon reaching the test pressure, hold for 5 minutes. The valve in the pressure line between the test pump and the boiler should then be closed, and the pressure drop occurring within 15 minutes shall be observed to see if any significant drop in pressure indicates leakage not already found. If the pressure drops more than 10 percent during the 15 minute period, it shall be assumed that pressure parts or valves are leaking at an unacceptable rate.

#### 3.2.1.6 Inspection

##### a. Under Pressure

All joints and connections shall be inspected for leaks or other defects while the vessel is under pressure. The pressure held during this inspection need not necessarily be equal to hydrostatic test pressure, but shall be not less than two-thirds of the hydrostatic test pressure. With hydrostatic pressure applied to the boiler, enter the fire side and inspect all tubes, drums, headers, and visible pressure parts. Particular attention shall be paid to points where tubes enter headers, drums, and tube sheets. Faults shall indicated with chalk or another marking device, and a notation should be made. Note the row and the number of tubes requiring replacement or rolling to facilitate their location by the owner. Inspect external pressure parts connected to the boiler. Welds and riveted joints shall be inspected carefully for leaks; valves shall also be checked for leaks. Upon completing the inspection, the pressure may be relieved.

##### b. Pressure Released

After the pressure has been released, observe to see if any permanent deformation has occurred. If any is found, refer to paragraph below for the necessary action to be taken.

##### c. Permanent Deformation

Where permanent deformation of the heads or of the boiler shell or drum has occurred, whether as a result of hydrostatic pressure tests or from normal operating pressures, repairs shall be made only after it has been definitely determined that such repairs are practicable and economical. After approved repairs of this nature have been completed, the maximum allowable working pressure of the boiler shall be recalculated. Prior to returning the boiler to service, a hydrostatic test, based on recalculated maximum allowable working pressure, shall be made.

#### 3.2.1.7 Gaskets



Replace manhole and handhole gaskets after performing the hydrostatic strength test. Replacement gaskets shall be boiler manufacturer's recommended replacement parts.

### 3.2.2 Operational Test

The boiler shall be brought up to operating pressure and temperature. All devices provided for controlling the operation and safety of the boiler, including controllers of steam or water pressure, water temperature, and boiler water level, shall be inspected and caused to function under operating condition. All associated valves and piping, pressure and temperature indicating devices, metering and recording devices and all boiler auxiliaries shall be inspected under operating conditions. All controls attached to the boiler, must be in good working order. Inspection and tests of boilers may be made with the main steam or hot water distribution valves closed or open, as necessary, to fire the boiler and operate it under normal operating conditions. Testing the function of control devices and apparatus which may interfere with the distribution requirements should be done with the main steam or hot water distribution valves closed, as applicable. The purpose of these inspections and tests is to discover any unsafe operation or maintenance of the boiler or its auxiliaries that may be evidenced under operating conditions. The test shall continue for at least 8 hours. All deficiencies shall be corrected at no cost to the Government.

#### 3.2.2.1 Firing Equipment

The operation of all firing equipment including oil burners, gas burners, fuel injectors, fuel igniters, burner safety controls and other such equipment provided to introduce fuel into the boiler furnace and to ignite the fuel, shall be inspected for any deficiency that may be evidenced under operating condition. Fuel leaks will not be allowable.

#### 3.2.2.2 Controls

Inspect the operation of all controls directly associated with the operation and safety of the boiler for any deficiencies preventing proper operation. These controls include such items as unloading valves, high pressure cut-out devices, high-temperature cut-out devices, low-pressure cut-in devices and burner safety controls.

Inspect the operation of combustion controls, steam pressure controls, water temperature controls and feed water controls. The combination controls and steam pressure control shall maintain proper steam pressure (or water temperature in high temperature water installations) and the air fuel ratio shall be satisfactorily demonstrated throughout the capacity range of the boiler and throughout the load swings encountered in operation on larger boilers.

Air-fuel ratio shall be checked by both carbon dioxide and oxygen measuring devices. Carbon monoxide shall also be checked. Check automatic boiler controls for the proper programming sequence and timing with respect to pre-purge, ignition, pilot proving, flame proving, and post purge periods.

Check the operation of flame failure and combustion air failure devices to insure that they properly shut-off the supply of fuel; this should be done by simulating a flame failure (by manually shutting off the fuel or by other means) and by observing the operation of the controls, solenoid valves and diaphragm operated valves which are to operate during a flame

failure.

The operation of automatic burner management systems shall comply with the ASME BPVC or ASME CSD-1 as applicable. Inspect feed-water controls and check the ability of the controls to maintain proper water level throughout the range of capacity with load swings.

Check the operation of the low water fuel cut-off and automatic water feeding devices by draining the float bowl, lowering the boiler water level and performing the necessary steps to cause these devices to function to ensure that they operate properly.

a. Sequencing

The boiler shall start, operate, and stop in strict accordance with specified operational sequence.

b. Flame Safeguard

Verify the operation of the flame safeguard controls by simulated flame and ignition failures. Test burners, having intermittent pilots, by simulating main flame failure while the pilot is burning. Verify the trail-for-pilot ignition, trail-for-main flame ignition, combustion control reaction, and valve closing times by stop watch.

c. Immunity to Hot Refractory

Operate the burner at high fire until the combustion chamber refractory reaches maximum temperature. The main fuel valve shall then be closed manually. The combustion safeguard shall drop out immediately causing the safety shut-off valves to close within the specified control reaction and valve closing times.

d. Pilot Intensity Required

Gradually reduce the fuel supply to the pilot flame to the point where the combustion safeguard begins to drop out (sense "no flame") but holds in until the main fuel valve opens. At this point of reduced pilot fuel supply, the pilot flame shall be capable of safely igniting the main burner. If the main fuel valve can be opened on a pilot flame of insufficient intensity to safely light the main flame, this is an unacceptable deficiency.

### 3.2.2.3 Piping and Piping Connections

While the boiler is operating, examine all pipes for deficiencies. If any are found, determine whether they are the result of excessive strains due to expansion, contraction, or other causes. Look for undue vibration, particularly in piping connections to the boiler. Where excessive vibration is found, examine connections and parts.

### 3.2.2.4 Safety Valve-Capacity Test

Verify that the relieving capacity of each safety valve is adequate for the capacity of the boiler by one of the following methods:

- a. By the accumulation test, which consists of shutting off all other steam-discharge outlets from the boiler and forcing the fires to

the maximum. The safety valve capacity shall be sufficient to prevent a pressure in excess of 6 percent above the maximum allowable working pressure. This method should not be used on a boiler with a superheater or reheater.

- b. By measuring the maximum amount of fuel that can be burned and computing the corresponding evaporative capacity (steam generating capacity) upon the basis of the heating value of this fuel.
- c. By determining the maximum evaporative capacity by measuring the feedwater.

When either of the methods outlined in b. or c. is employed, the total safety valve capacity shall be equal to or greater than the maximum evaporative capacity (maximum steam generating capacity) of the boiler.

### 3.2.3 Devices

#### 3.2.3.1 Temperature Indicating Devices

All temperature indicating devices shall be observed for indications of excessive temperatures, particularly during and immediately following the time when high load demands are made on the boiler.

#### 3.2.3.2 Metering and Recording Devices

While the boiler is operating under normal conditions, observe the operation of all metering and recording devices. When there is evidence that any such device is not functioning properly, it shall be adjusted, repaired or replaced as necessary.

### 3.2.4 Valves

#### 3.2.4.1 Blow-down Valves

Test the freedom of each blow-down valve and its connections by opening the valve and blowing down the boiler for a few seconds. Determine whether the valve is defective and whether there is evidence of restrictions in the valve or connected piping preventing proper blow-down of boiler.

#### 3.2.4.2 Stop and Check Valves

While the boiler is operating, inspect the operating conditions of each stop and check valve where possible. Serious defects of externally controlled stop valves may be detected by operating the valve when it is under pressure. Similarly, defects in check valves may be detected by listening to the operation of the valve or by observing any excessive vibration of the valve as it operates under pressure.

#### 3.2.4.3 Pressure Reducing Valves

While there is pressure on the system, open and close the by-pass valve, as safety and operating conditions permit, and observe the fluctuation of the pressure gage pointer as an aid to determining possible defects in the operation of the pressure reducing valve or the pressure gage. Look for any evidence that may indicate improper condition of the relief or safety valves provided for pressure reducing valve.

### 3.2.5 Boiler Auxiliaries

While the boiler is operating under normal conditions, observe the operation of all boiler auxiliaries for any defects which may prevent the proper functioning of boiler. Observe the operating practice of auxiliaries. The unnecessary use of multiple auxiliaries or the use of a large auxiliary during a light load period (when a smaller auxiliary could be substituted) should be discouraged. The maximum use of steam driven auxiliaries short of atmospheric exhaust shall be encouraged. Steam leaks and wastage to atmosphere, should be called to the attention of the operating personnel. Particular attention should be given to deaerator venting practice. Venting should be held to the minimum required to preclude oxygen entrainment in the feedwater.

#### 3.2.6 Boiler and Feedwater Treatment

The operation of equipment provided for boiler and feedwater treatment shall be observed, and the materials and procedures used for boiler and feedwater treatment should be checked to ensure adequate against scale and corrosion in the boiler, plant, equipment and distribution system. If an effective boiler water treatment program is not being implemented, indicate this on the inspection report.

#### 3.3 REPAIRS

Prior to issuing a certificate, all deficiencies discovered during the external and internal inspections, the pressure test and the operational tests, shall be corrected by the Contractor at no cost to the Government.

#### 3.4 INSPECTION REPORTS AND CERTIFICATE

The following forms shall be used in the inspection and testing of boilers. Copies of each form are available from the Contracting Officer.

##### 3.4.1 Data Record Sheets for Boiler

This form shall be prepared, by the inspector, when performing the initial inspection on a boiler. Forward this report to the Contracting Officer for approval within 30 calendar days after the inspection.

##### 3.4.2 Inspection Report for Boilers

The inspector shall complete this form to record the condition of each boiler, the test performed, and the issuance of the certificate. Forward this report to the Contracting Officer for approval within 30 calendar days of the inspection.

##### 3.4.3 Inspection Certificate for Boiler's

A current and valid certificate, or commercial equivalent authorized by the Contracting Officer for contract inspection, shall be posted on or near the boiler under glass or other protective covering. Operation of the equipment without the certificate is not authorized. Issuance of this certificate shall be determined by the following criteria:

- a. No Deficiencies: The inspector shall complete and sign after the test or inspection.
- b. Deficiencies Not Affecting Operating Safety: Certificate may be issued, but corrections must be recorded on the Inspection Report

for Boilers.

- c. Deficiencies Affecting Operating Safety: Certificate shall be withheld until deficiencies are corrected and boiler re-inspected. The Contracting Officer shall be notified, in writing, of the specific deficiencies.
- d. Pressure Reduction: Certificate shall be issued for the reduced working pressure. Notification in writing, shall be made by the inspector to the Contracting Officer.
- e. Unserviceable: Certificate will not be issued. The Contracting Officer shall be notified, in writing, of the deficiencies.

-- End of Section --